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CSO Master Plan

Alexander District Plan

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City of Winnipeg

CSO Master Plan

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1. Alexander District

1.1 District Description

Alexander district is located in the centre of the combined sewer (CS) area along the western edge of the Red River and north of Bannatyne district. Alexander is approximately bounded by Pacific Avenue and Elgin Avenue to the south, Xante Street and Trinity Street to the west, Higgins Avenue to the north, and the Red River to the east. The Canadian Pacific Railway (CPR) Mainline acts as the northern border crossing Main Street parallel with Higgins Avenue.

The land use within Alexander is distributed between industrial, multiple-use sector, and residential areas. General manufacturing exists north of Logan Avenue from Arlington Street to Stanley Street located next to the CPR Mainline. The residential sections include two-family and multi-family buildings and are located south of Logan Avenue, while the multiple-use sector is located in the eastern area of Alexander district. The National Microbiology Laboratory is the only institutional area in the district. China Town is included as part of the multiple-use sector and is located next to Main Street in the downtown area.

Main Street, Disraeli Freeway, Logan Avenue, Isabel Street, Sherbrook Street, and Arlington Street are regional transportation routes that pass through Alexander district. Greenspace within Alexander is limited due to the high residential and commercial density. Approximately 6 ha of the district is classified as greenspace. The more significant parcels of greenspace are identified as Central Community Centre, Pioneer Athletic Grounds, Dufferin Park, and a section of Fort Douglas Park on the riverbank.

1.2 Development

Alexander district includes a significant portion of the downtown area and the potential for redevelopment in the future is high. The OurWinnipeg development plan has prioritized the downtown for opportunities to create complete, mixed-use, higher density communities. Redevelopment within this area could impact the CS system and will be investigated on a case-by-case basis for potential impacts to the combined sewer overflow (CSO) Master Plan. All developments within the CS districts are mandated to offset any peak combined sewage discharge by adding localized storage and flow restrictions, in order to comply with Clause 8 of the Environment Act Licence 3042.

A portion of Main Street is located within the Alexander district. Portage Avenue is identified as Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Main Street is to be promoted in the future.

A portion of the South Point Douglas Lands Major Redevelopment Site is located within the Alexander district. This site includes the lands adjacent to the Assiniboine River north of the Waterfront neighborhood. This Major Redevelopment Site is considered underused and will be prioritized to be developed into a higher density, mixed-use community.

Main Street, Princess Street, King Street, and Higgins Avenue within the Alexander district have been identified as part of the potential routes for the Eastern Corridor of Winnipeg's Bus Rapid Transit. The work along these streets could result in additional development in the area. This could also present an opportunity to coordinate sewer separation works alongside the transit corridor development, providing further separation within the Alexander district. This would reduce the extent of the Control Options listed in this plan required.

1.3 Existing Sewer System

Alexander district encompasses an area of 157 ha[1] based on the district boundary GIS information, and includes a CS system and a storm relief sewer (SRS) system. Included in this area is approximately 1 ha that contains a separate land drainage sewer (LDS) system and is partially separated, and approximately 2 ha that is considered separation ready.

The Alexander district does not contain an independent lift station (LS) to transport intercepted CS, instead all CS intercepted by the primary weir is conveyed to the Interceptor system entirely by gravity. The CS system includes a diversion chamber, flood pump station (FPS) and CS outfall gate chamber..). The Alexander FPS and CS outfall are located next to the Red River at the end of Galt Avenue and Waterfront Drive. The diversion chamber is set further north from the CS outfall at Galt Avenue and Lily Street, and redirects flow from the CS to the Main Interceptor on Main Street. The CS system drains towards the Alexander CS outfall, located at the eastern end of Galt Avenue, where combined sewage is intercepted or may be discharged into the Red River under high wet weather flow (WWF) conditions. There are two main sewer trunks that connect at the diversion chamber. Sewage from the area west of Main Street is collected in a 1500 mm sewer trunk that extends along Logan Avenue. A 450 mm CS trunk collects sewage from a small area south of Galt Avenue and east of Main Street. The two sewers converge at the Lily Street diversion chamber and connect into a 600 mm interceptor that connects to the Main Interceptor on Main Street.

During WWF events, the SRS system provides relief to the CS system in Alexander district. The SRS system that extends through Alexander includes multiple interconnects with the SRS network in the Bannatyne district, where it is ultimately discharged into the Red River at the McDermot SRS outfall on the eastern end of McDermot Avenue within the Bannatyne district. Note there are no dedicated SRS outfalls within the Alexander district. The SRS system is installed in specific sections west of Main Street and connects to the CSs via interconnections with a system of high overflow pipes and weirs. Most catchbasins are still connected to the CS system, so no partial separation utilizing these SRS pipes has been completed.

During dry weather flow (DWF), the SRS system is not required; sanitary sewage is intercepted by the primary weir at the CS outfall and into the Alexander diversion chamber, where it flows by gravity through the 600 mm interceptor pipe to the Main Interceptor sewer and eventually flows to the North End Sewage Treatment Plan (NEWPCC) for treatment.

During wet weather flow (WWF), any flow that exceeds the primary diversion weir capacity overtops the weir, and is discharged through the gate chamber to the Red River. Within the gate chamber a sluice gate is installed on the CS outfall, along with a flap gate to restrict back-up from the Red River into the CS system. When the river level is high the flap gate makes it so that gravity discharge of excess CS which has overtopped the primary weir is not possible. Under these conditions the excess flow is instead pumped by the Alexander flood pumping station (FPS) to discharge to the river at a point downstream of the flap gate.

The one outfall to the Red River (one CS) is as follows:

- ID19 (S-MA70021229) – Galt CS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Alexander and the surrounding districts. Each interconnection is shown on Figure 01 and shows locations where gravity and pumped flow can cross from one district to another. Each interconnection is listed as follows:

[1] City of Winnipeg GIS information relied upon for area statistics. The GIS records may vary slightly from the city representation in the InfoWorks sewer mode. Therefore, minor discrepancies in the area values reported in Section 1.3 Existing Sewer System and in Section 1.8 Performance Estimate may occur.

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Syndicate

- The 1950 mm Main Interceptor pipe flows by gravity north on Main Street into Syndicate district to carry sewage to the NEWPCC for treatment:
  - Invert at Syndicate district boundary 221.11 m (S-MH20017375)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Bannatyne

- The 1950 mm Main Interceptor pipe flows by gravity north on Main Street into Alexander district to carry sewage to the NEWPCC for treatment:
  - Invert at Alexander district boundary 221.37 m (S-MH20017277)

1.3.1.3 District Interconnections

Aubrey

<u>CS to CS</u>

- A 375 mm CS flows east on Alexander Avenue from Alexander district into a 1450x1875 CS at the intersection of Alexander Avenue and Xante Street that enters Aubrey district:
  - Invert at Alexander district boundary 228.49 m (S-MH20017584)
- High point manhole:
  - Henry Avenue at Tecumseh Street – 229.96 m (S-MH20017866)
  - Logan Avenue – 228.77 m (S-MH20017639)
  - Pacific Avenue – 229.30 m (S-MH20017548)
  - Elgin Avenue – 229.49 m (S-MH20017513)

<u>SRS to SRS</u>

- An 1800 mm SRS flows east by gravity and a 375 mm SRS flows west on Alexander Avenue exit Alexander district and enter Aubrey district at the intersection of Alexander Avenue and Xante Street:
  - Invert at Alexander district boundary 224.43 m (S-MA20019577)
  - Invert at Aubrey district boundary 225.13 m (S-MH70028380)

Bannatyne

<u>CS to CS</u>

- A 375 mm CS flows northbound on Princess Street from Bannatyne district and connects to the CS system in Alexander district:
  - Invert at Bannatyne district boundary 227.44 m (S-MH20017220)
- High point CS manhole:
  - Arlington Street – 229.54 m (S-MH20016288)

<u>CS to SRS</u>

- A 450 mm CS flows by gravity north on Sherbrook Street. The manhole includes an interconnection to the Bannatyne SRS network with a 750 mm overflow SRS:
  - Invert at Bannatyne district boundary 227.67 m (S-MA70026573)

SRS to SRS

- A 450 mm SRS flows by gravity west on Ross Avenue to Tecumseh Street and connects to the SRS system in Alexander district:
  - Invert at Alexander district boundary 227.43 mm (S-MA70062533)
- A 525 mm SRS flows southbound by gravity from Alexander district into the Bannatyne district SRS network on Arlington Street:
  - Invert at Alexander district boundary 228.39 m (S-MH70028427)
- A 1200 mm SRS flows by gravity along Tecumseh Street and into Bannatyne district at the intersection of Tecumseh and Elgin Avenue, serving a section of Alexander district. It connects to the SRS system on William Avenue:
  - Invert at Alexander district boundary 227.03 m (S-MH70028468)
- A 1050 mm SRS flows southbound by gravity on Sherbrook Street, while a 450 mm SRS flows westbound on Ross Avenue. Both SRSs flow from Alexander district, into a manhole at the intersection of Sherbrook Street and Ross Avenue, and connect to the SRS system in Bannatyne district:
  - Invert at Bannatyne district boundary on Sherbrook Street 226.03 m (S-MH70028633)
  - Invert at Bannatyne district boundary on Ross Avenue 226.30 m (S-MA70062775)
- A 1050 mm SRS flowing southbound into Bannatyne by gravity on Isabel Street connects to the SRS network on William Avenue. The SRS interconnects with the CS system in Alexander district flowing south from Logan Avenue into Bannatyne Avenue:
  - Invert at Bannatyne district boundary 225.15 m (S-MH70032777)
- A 750 mm SRS flows from the SRS network in Alexander district into Bannatyne district by gravity on Ellen Street:
  - Invert at Bannatyne district boundary 224.90 m (S-MH70029529)
- A 750 mm SRS consisting of a weir overflows during high rainfall events at the corner of Princess Street and Rupert Avenue and flows by gravity eastbound on Rupert Avenue to connect to the SRS system in Bannatyne district:
  - Invert at Alexander district boundary 225.39 m (S-MH70045620) Weir height – 227.15 m
- A 900 mm SRS flows by gravity south on King Street from Alexander district and crosses into Bannatyne district at the intersection of King Street and Pacific Avenue:
  - Invert at Bannatyne district boundary 224.59 m (S-MH70045558)

LDS to LDS

- A 525 mm LDS serves the National Microbiology Laboratory between Alexander Avenue and William Avenue. The LDS flows by gravity into Bannatyne and connects to the SRS network in Bannatyne at the corner of Tecumseh Street and Elgin Avenue:
  - Invert at Bannatyne district boundary 229.33 m (S-MH70008110)
- A 450 mm LDS flows south into Bannatyne district at the intersection of Pacific Avenue and Waterfront Drive and is discharged to the main Bannatyne CS outfall:
  - Invert at Bannatyne district boundary on Waterfront Drive 225.92 m (S-MH70014314)

LDS to SRS

- A 300 mm LDS flows by gravity east into Bannatyne and connects to the SRS system in Bannatyne at the corner of Tecumseh Street and Elgin Avenue:
  - Invert at Bannatyne district boundary 230.10 m (S-MA70022800)

A district interconnection schematic is included as Figure 1-1. The drawing illustrates the collection areas, interconnections, pumping systems, and discharge points for the existing system.

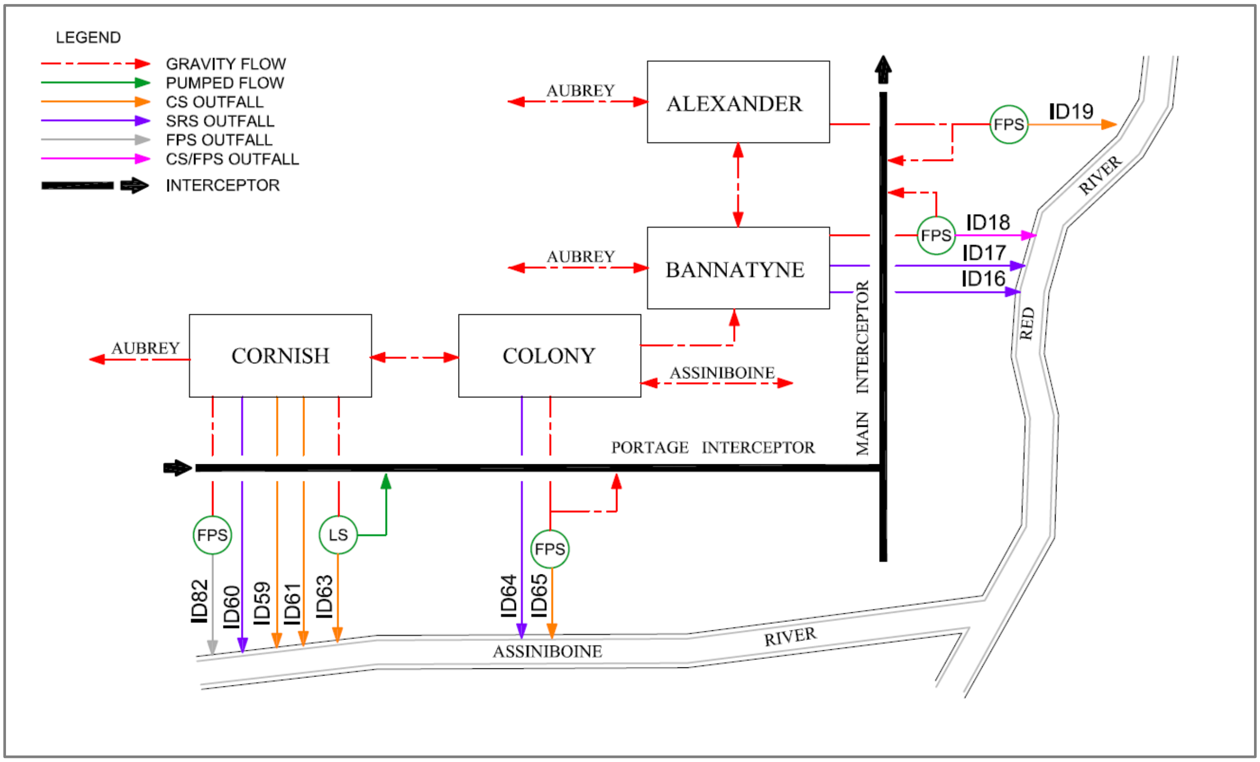


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 01 and listed in Table 1-1.

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Combined Sewer Outfall (ID19)	S-AC70009998.1	S-MA70021229	1500 mm	Red River Invert: 223.88 m
Flood Pumping Outfall (ID19)	S-AC70009998.1	S-MA70021229	1500 mm	Red River Invert: 223.88 m
Other Overflows	N/A	N/A	N/A	
Main Trunk	S-MH20012121.1	S-MA70021213	1500 mm	Circular Invert: 224.03 m
SRS Outfalls	N/A	N/A	N/A	No dedicated SRS outfall in this district.
SRS Interconnections	N/A	N/A	N/A	36 SRS - CS
Main Trunk Flap Gate	S-AC70009987.1	S-CG00001074	1500 x 1500 mm	Flap gate size Invert: 224.37 m
Main Trunk Sluice Gate	ALEXANDER_GC.1	S-CG00001073	1500 x 1500 mm	Invert: 223.78 m
Off-Take	S-TE70007762.2	S-MA70016914	600 mm	Invert: 224.57 m
Dry Well	N/A	N/A	N/A	Diversion structure, no LS as part of outfall.

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station Total Capacity	N/A	S-MA70016914 (1)	600 mm (1)	600 mm gravity pipe relied on for pass forward flow, capacity 0.5 m^3/s(2) (downstream 300mm sluice – capacity 0.35 m^3/s)
ADWF	N/A	N/A	0.0346 m^3/s	
Lift Station Force Main	N/A	N/A	N/A	Diversion structure, no lift station force main as part of outfall.
Flood Pump Station Total Capacity	N/A	N/A	0.920 m^3/s	1 x 0.52 m^3/s 1 x 0.400 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.220 m^3/s	

Notes:

ADWF = average dry-weather flow
GIS = geographic information system
ID = identification
N/A = not applicable

(1) Gravity pipe replacing Lift Station as Alexander is a gravity discharge district

(2) Between diversion chamber and main interceptor sewer there is a modelled 300 mm sluice that needs to be investigated. The sluice further limits the pass forward flow to 0.35 m^3/s.

The critical system elevations for the existing system relevant to the development of the CSO control options are listed in Table 1-2. Critical elevation reference points are identified on the district overview and detailed maps.

Table 1-2. Critical Elevations

Reference Point	Item	Elevation (m)[a]
1	Normal Summer River Level	Alexander – 223.72
2	Trunk Invert at Off-Take	224.57 (diversion chamber)
3	Top of Weir	224.94
4	Relief Outfall Invert at Flap Gate	N/A
5	Relief Interconnection (S-MH70029532)	226.34
6	Sewer District Interconnection (Bannatyne)	221.37
7	Low Basement	228.60
8	Flood Protection Level (Alexander, Bannatyne)	229.78

[a] City of Winnipeg Data, 2013

1.4 Previous Investment Work

Table 1-3 provides a summary of the district status in terms of data capture and study. The most recent study completed in Bannatyne was the *Alexander and Bannatyne Combined Sewer Districts Sewer Relief and CSO Abatement Study* (AECOM, 2009). The study's purpose was to identify and recommend sewer relief and CSO abatement options for the Alexander and Bannatyne districts. Sewer relief projects completed as part of the basement flood relief program were last completed in 2010. An SRS latent storage pump system was installed near the McDermot SRS outfall in 2014 and has been undergoing operational evaluations since that time.

Between 2009 and 2015, the City invested $12 million in the CSO Outfall Monitoring Program. The program was initiated to permanently installing instruments in the primary CSO outfalls. The Galt outfall from the Alexander CS district was included as part of this program. Instruments installed at each of the thirty nine primary CSO outfall locations have a combination of inflow and overflow level meters and flap gate inclinometers if available.

Table 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Expected Completion
7 – Bannatyne	2009[a]	Future Work	2013	Study Complete	N/A

[a] = Sewer relief projects: Contracts 1B, 1A, 2A, 2B, 3A, 3B, 4, 5 & 8 completed associated with this study

1.5 Ongoing Investment Work

There are plans to replace the existing diversion structure for the Galt outfall at Lily Street and Galt Avenue. As part of this work, a new off-take pipe is to be constructed leading to the interceptor for the district. This work is anticipated to take place in the next five years.

There is ongoing maintenance and calibration of permanent instruments installed within the Galt primary outfall within the Alexander district. This consists of monthly site visits in confined entry spaces to verify that physical readings concur with displayed transmitted readings and replacing desiccants where necessary.

1.6 Control Option 1 Projects

1.6.1 Project Selection

The proposed projects selected to meet Control Option 1 – 85 Percent Capture in a Representative Year for the Assiniboine district are listed in Table 1-4. The proposed CSO control projects will include gravity flow control, screening, and floatable management. Program opportunities including green infrastructure (GI) and real time control (RTC) will also be included as applicable.

Table 1-4. District Control Option

Control Limit	Latent Storage	Flap Gate Control	Gravity Flow Control	Control Gate	In-line Storage	Off-line Storage Tank	Off-line Storage Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
85 Percent Capture in a Representative Year	-	-	✓	-	✓ [a]	-	-	-	✓	✓	✓

Notes: [a] = screening only, existing high-level weir

- = not included

✓ = included

The existing CS system in the Alexander district has a high level primary weir already installed. Therefore in-line storage has not been recommended in this district.

A gravity flow controller is proposed on the CS system to allow the dewatering rate from the district back into the Main Street interceptor to be monitored.

Floatable control will be necessary to capture any undesirable floatables in the sewage. All primary overflow locations are to be screened under the current CSO control plan, installation of a screening chamber will be required for the screen operation, and the existing weir will provide the mechanism for continuing capture of the existing in-line storage. In the Alexander district, a high level weir is currently in operation and the screen will be situated downstream of this structure.

GI and RTC will be applied within each district on a system-wide basis with consideration of the entire CS area. The level of implementation for each district will be determined through evaluations completed through district level preliminary design.

1.6.2 Gravity Flow Control

Alexander district does not include a lift station (LS) and discharges directly to the Main Interceptor by gravity. A flow control device will be required to control the diversion rate for future RTC and dewatering assessments. A standard flow control device was selected as described in Part 3C.

The flow controller will be installed at an optimal location downstream of the diversion chamber at the intersection of Galt Avenue and Lily Street. Figure 01-02 identifies a conceptual location for flow controller installation. A small chamber or manhole with access for cleaning and maintenance will be required. The flow controller will operate independently and require minimal operation interaction. The diversion weir at the CS outfall may have to be adjusted to match the hydraulic performance of the flow controller.

A gravity flow controller has been included as a consideration in developing a fully optimized CS system as part of the City's long-term objective. The operation and configuration of the gravity flow controller will have to be further reviewed for additional flow and rainfall scenarios.

1.6.3 Floatables Management

Floatables management may require installation of a screening system to capture floatable materials. The off-line screens would be designed to maintain the current level of basement flooding protection.

The type and size of screens depend on the LS and the hydraulic head available for operation. A standard design was assumed for screening and is described in Part 3C. The design criteria for screening, with gate control implemented, are listed in Table 1-5.

Table 1-5. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate (Existing Weir)	224.94 m	Existing Static Weir Level
Normal Summer Water Level	223.72 m	
Maximum Screen Head	1.22 m	
Peak Screening Rate	0.74 m^3/s	Bypass to be installed to match district first flush peak flow rate
Screen Size	1.5 m x 1.0 m	Modelled Screen Size

The proposed screening chamber would be located within the existing combined trunk sewer downstream of the primary weir, as shown on Figure 01-01. The screens would operate once levels within the sewer surpassed the existing primary weir elevation. The overflow will continue to be directed to the outfall, with the screens located in the new screening chamber, with screened flow discharged to the upstream side of the existing gate to the river. The screening chamber would include screening pumps with a discharge returning the screened material back to the interceptor and on to the NEWPCC for removal. This would require a force main to be installed along Galt Avenue from the FPs to the downstream side of the gravity flow controller. A bypass would also be installed to limit the overflow volume to be screened to match that of the other proposed screening units in the system. The dimensions for the screen chamber to accommodate influent from the existing overflow CS sewer, the screen area, and the routing of discharge piping 3.2 m in length and 3.1 m in width.

1.6.4 Green Infrastructure

The approach to GI is described in Section 5.2.1 of Part 2 of the CSO Master Plan. Opportunities for the application of GI will be evaluated and applied with any projects completed in the district. Opportunistic GI will be evaluated for the entire district during any preliminary design completed. The land use, topography, and soil classification for the district will be reviewed to identify applicable GI controls.

Alexander has been classified as a low to medium GI potential district. Land use in Alexander is mix of residential, commercial, and institutional, the east end of the district is bounded by the Red River. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention. There are a few commercial areas which may be suitable to green roofs and parking lot areas which would be ideal for paved porous pavement.

1.6.5 Real Time Control

The approach to RTC is described in Section 5.2.2 of Part 2 of the CSO Master Plan. The application of RTC will be evaluated and applied on a district by district basis through the CSO Master Plan projects with long term consideration for implementation on a system wide basis.

1.7 System Operations and Maintenance

System operations and maintenance (O&M) changes will be required to address the proposed control options. This section identifies general O&M requirements for each control option proposed for the district. More specific details on the assumptions used for quantifying the O&M requirements are described in Part 3C of the CSO Master Plan.

The flow controller will require the installation of a chamber and flow control equipment. Monitoring and control instrumentation will be required. The flow controller will operate independently and require minimal operation interaction. Regular maintenance of the flow controller chamber and appurtenances will be required.

Floatable control with outfall screening will require the addition of another chamber with screening equipment installed. The chamber will be installed downstream of the primary weir. Screening operation will occur during WWF events that surpass the in-line storage control level. WWF would be directed from the main outfall trunk and directly through the screens to discharge into the river. The screens will operate intermittently during wet weather events and will likely require operations review and maintenance after each event. The frequency of a screened event would correlate to the number overflows identified for the district. Having the screenings pumped back to the interceptor system via a small LS and force main will be required. The screenings return will require O&M inspection after each event to assess the performance of the return pump system.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. An individual model was created to represent the sewer system baseline as represented in the year 2013 and a model for the CSO Master Plan with the control options implemented in the year 2037. A summary of relevant model data is summarized in Table 1-6.

Table 1-6. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	157	157	3,212	74	N/A
2037 Master Plan – Control Option 1	157	157	3,212	74	SC

Notes:

SC – Screening

No change to the future population was completed as from a wastewater generation perspective from the update to the 2013 Baseline Model to the 2037 Master Plan Model. The population generating all future wastewater will be the same due to Clause 8 of Environment Act Licence 3042 being in effect for the CS district.

City of Winnipeg hydraulic model relied upon for area statistics. The hydraulic model representation may vary slightly from the City of Winnipeg GIS Records. Therefore, minor discrepancies in the area values reported in Section 1.3 Existing Sewer System, and in Section 1,8 Performance Estimate may occur.

The performance results listed in Table 1-7 are for the hydraulic model simulations using the year-round 1992 representative year. This table lists the results for the Baseline, for each individual control option and for the proposed CSO Master Plan – Control Option 1. The Baseline and Control Option 1 performance numbers represent the comparison between the existing system and the proposed control options. Table 1-7also includes overflow volumes specific to each individual control option: these are listed to provide an indication of benefit gained only and are independent volume reductions.

Table 1-7. Performance Summary – Control Option 1

Control Option	Preliminary Proposal	Master Plan			
	Annual Overflow Volume (m^3)	Annual Overflow Volume (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow [a]
Baseline (2013)	20,726	26,851	-	16	0.220 m^3/s
Control Option 1	**18,134**	**26,142**	**708**	**15**	**0.225 m^3/s**

[a] Pass forward flows assessed on the 1-year design rainfall event.

The percent capture performance measure is not included in Table 1-7, as it is applicable to the entire CS system and not for each district individually.

1.9 Cost Estimates

Cost estimates were prepared during the development of the Preliminary Proposal and have been updated for the CSO Master Plan. The CSO Master Plan cost estimates have been prepared for each control option, with overall program costs summarized and described in Section 3.4 of Part 3A. The cost estimate for each control option relevant to the district as determined in the Preliminary Proposal and updated for the CSO Master Plan are identified in Table 1-8. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 to plus 100 percent.

Table 1-8. Cost Estimate – Control Option 1

Control Option	2014 Preliminary Proposal Capital Cost	2019 CSO Master Plan Capital Cost	2019 Annual Operations and Maintenance Cost	2019 Total Operations and Maintenance Cost (Over 35-year period)
Screening	- [a]	$2,680,000 [c]	$30,000 [c]	$650,000
Gravity Flow Control	N/A [b]	$1,280,000	$35,000	$740,000
Subtotal	**N/A**	**$3,960,000**	**$65,000**	**$1,390,000**
Opportunities	N/A	$400,000	$6,000	$140,000
District Total	**N/A**	**$4,360,000**	**$71,000**	**$1,530,000**

[a] Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for this item of work found to be $600,000 in 2014 dollars

[b] Gravity Flow Control not included in the Preliminary Proposal

[c] Cost for bespoke screenings return pump not included in Master Plan as will depend on selection of screen and type of screening return system selected

The estimates include changes to the control option selection since the Preliminary Proposal, updated construction costs, and the addition of GI opportunities. The calculations for the CSO Master Plan cost estimate includes the following:

- Capital costs and O&M costs are reported in terms of present value.
- A fixed allowance of 10 percent has been included for GI, with no additional cost for RTC. This has been listed as part of the Opportunities costs.
- The Preliminary Proposal capital cost is in 2014-dollar values.
- The CSO Master Plan capital cost is based on the control options presented in this plan and in 2019-dollar values.
- The 2019 Total Annual Operations and Maintenance (over 35-year period) cost component is the present value costs of each annual O&M cost under the assumption that each control option was initiated in 2019.
- The 2019 Annual Operations and Maintenance Costs were based on the estimated additional O&M costs annually for each control option in 2019 dollars.
- Future costs will be inflated to the year of construction.

Cost estimates were prepared during the development of the Preliminary Proposal and updated for Phase 3 during the CSO Master Plan development. The differences identified between the Preliminary Proposal and the CSO Master Plan are accounting for the progression from an initial estimate used to compare a series of control options, to an estimate focusing on a specific level of control for each district. Any significant differences between the Preliminary Proposal and CSO Master Plan estimates are identified in Table 1-9.

Table 1-9. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Screening	Screening was not included in the preliminary estimate	Added to the Master Plan
	Gravity Flow Control	A flow controller was not included in the preliminary estimate	Added for the Master Plan to further reduce overflows and optimize in-line storage provided.
Opportunities	A fixed allowance of 10 percent has been included for program opportunities.	Preliminary Proposal estimate did not include a cost for GI opportunities.	
Lifecycle Cost	The lifecycle costs have been adjusted to 35 years	City of Winnipeg Asset Management approach.	
Cost escalation from 2014 to 2019	Capital Costs have been inflated to 2019 values based on an assumed value of 3 percent per for construction inflation.	Preliminary Proposal estimates were based on 2014-dollar values.	

1.10 Meeting Future Performance Targets

The regulatory process requires consideration for upgrading Control Option 1 to another higher-level performance target. For the purposes of this CSO Master Plan, the future performance target is 98 percent capture for the representative year measured on a system-wide basis. This target will permit the number of overflows and percent capture to vary by district to meet 98 percent capture. Table 1-10 provides a description of how the regulatory target adjustment could be met by building off the proposed work identified in Control Option 1.

Overall the Alexander district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture in the representative year future performance target. Opportunistic separation of portions of the district may be achieve with synergies with other major infrastructure work to address future performance targets. To achieve additional future volume capture, an off-line storage element such as underground tank or storage tunnel with associated dewatering pump infrastructure would be proposed. In addition, green infrastructure could potentially be utilized in key locations to provide additional storage and increase capture volume as necessary.

Table 1-10. Upgrade to 98 Percent Capture in a Representative Year Summary

Upgrade Option	Viable Migration Options
98 Percent Capture in a Representative Year	• Opportunistic Separation • Off-line Storage (Tank/Tunnel) • Increased use of GI

The control option for the Alexander district has been aligned to the primary outfalls being screened under the current CSO 85 percent capture control plan. The expandability of this district to meet the 98 percent capture would be assessed based on a system wide basis. The applicability of the listed migration options will be stepped than full district solutions.

The cost for upgrading to meet an enhanced performance target depends on the summation of all changes made to control options in individual districts and has not been fully estimated at this stage of master planning. The Phase In approach is to be presented in detail in a second submission for 98 percent capture in a representative year, due on or before April 30, 2030.

1.11 Risks and Opportunities

The CSO Master Plan and implementation program are large and complex, with many risks having both negative and positive effects. The objective of this section is to identify significant risks and opportunities for each control option within a district.

The CSO Master Plan has considered risks and opportunities on a program and project delivery level, as described in Section 5 of Part 2 of the CSO Master Plan. A Risk And Opportunity Control Option Matrix covering the district control options has been developed and is included as part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-11.

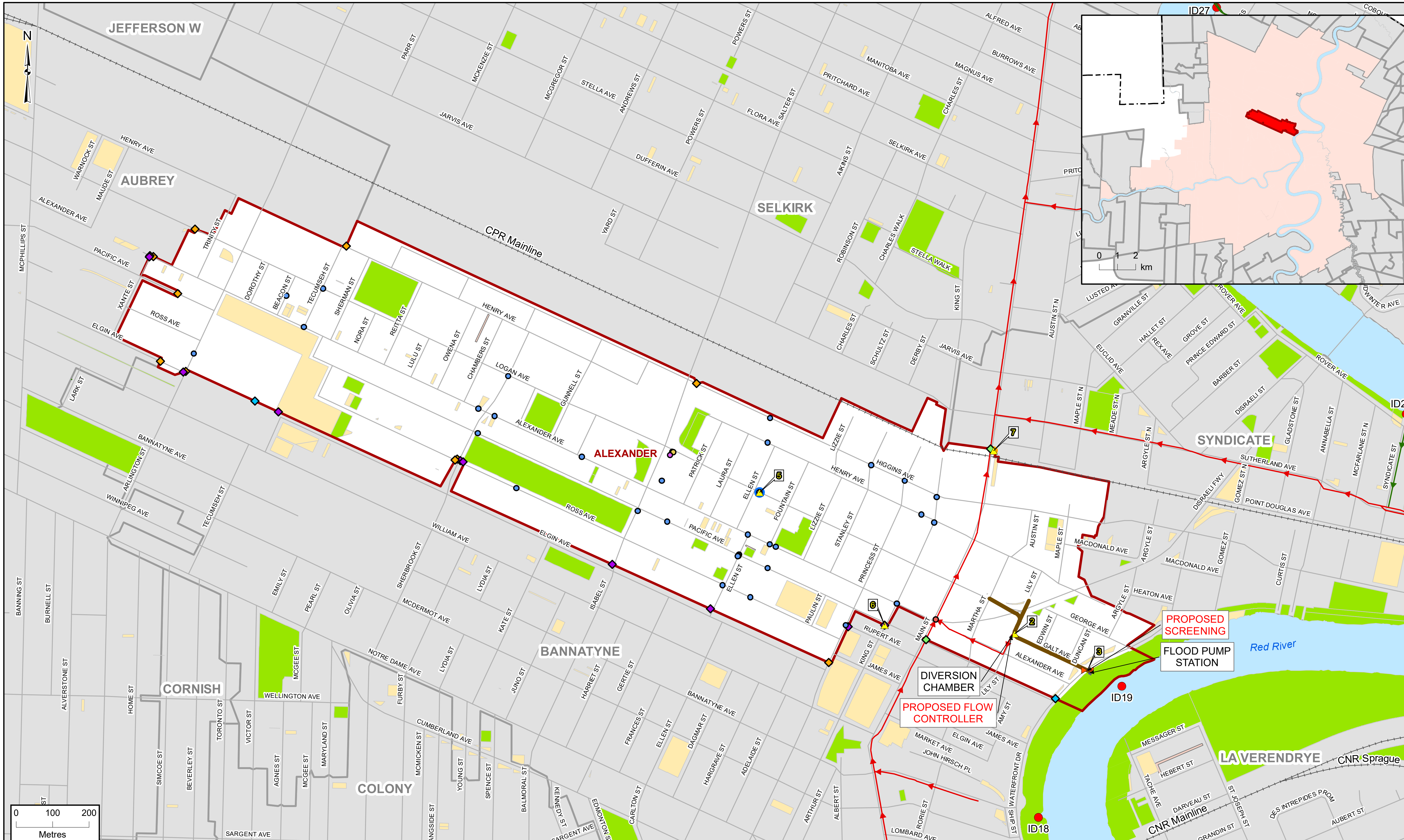
Table 1-11. Control Option 1 Significant Risks and Opportunities

Risk Number	Risk Component	Latent Storage / Flap Gate Control	In-line Storage / Control Gate	Off-line Storage Tank	Off-line Storage Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
1	Basement Flooding Protection	-	-	-	-	-	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	-	-	-	-	-
8	Program Cost	-	-	-	-	-	-	-	O
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	-	O	O	-
12	Operations and Maintenance	-	-	-	-	-	R	O	R
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	-	O	O	R

Risks and opportunities will require further review and actions at the time of project implementation.

1.12 References

AECOM. 2009. *Alexander and Bannatyne Combined Sewer Districts Sewer Relief and CSO Abatement Study*. Prepared for the City of Winnipeg. April.



LEGEND

Inter-System Connection	District Boundary Crossing		
Primary Weir	CS - LDS	CS	Extent of Existing In-line Storage
Critical Elevation	CS - WWS	LDS	Interceptor Sewer
CSO Outfall	SRS - CS	SRS	Force Main
Low CS Manhole	SRS - LDS	WWS	Street
Low SRS Connection			Railway

District Boundary
Watercourse
Greenspace
City Owned Land

CSO MASTER PLAN PROPOSED SOLUTIONS

Screening
Flow Controller

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

JACOBS

Notes:
1. Map data source - City of Winnipeg, 2013

Winnipeg

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 01
District Overview Map
Sewer District: Alexander
City of Winnipeg
Combined Sewer Overflow Master Plan

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LEGEND

- Primary Weir
- CSO Outfall
- Manhole
- Flap Gate
- Sluice Gate
- Pump Location

Sewer By Type
- CS
- LDS
- WWS

Pump Station Type
- Flood Pump Station

CSO MASTER PLAN
PROPOSED SOLUTIONS
- Screening

ALL PROPOSED SOLUTIONS
SHOWN IN RED TEXT

JACOBS

Notes:
1. Map data source - City of Winnipeg, 2013

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 01-01
Screening
Sewer District: Alexander
City of Winnipeg
Combined Sewer Overflow Master Plan

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LEGEND

- Critical Elevation
- Manhole

Sewer By Type
- CS

Pump Station Type
- Diversion Chamber

Land Parcel

CSO MASTER PLAN
PROPOSED SOLUTIONS
- Flow Controller

ALL PROPOSED SOLUTIONS
SHOWN IN RED TEXT

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Notes:
1. Map data source - City of Winnipeg, 2013

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WATER AND WASTE DEPARTMENT

FIGURE 01-02
Flow Controller
Sewer District: Alexander
City of Winnipeg
Combined Sewer Overflow Master Plan

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